

# ***U.S. Fusion Energy Sciences Program***

---

Presented to the

## **18<sup>th</sup> Executive Secretaries Meeting U.S. - Japan**

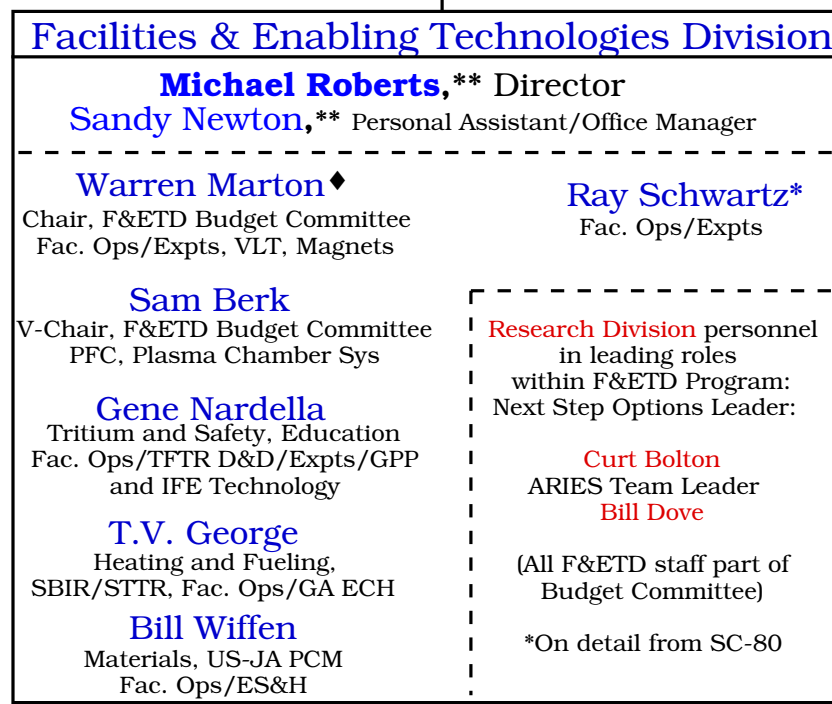
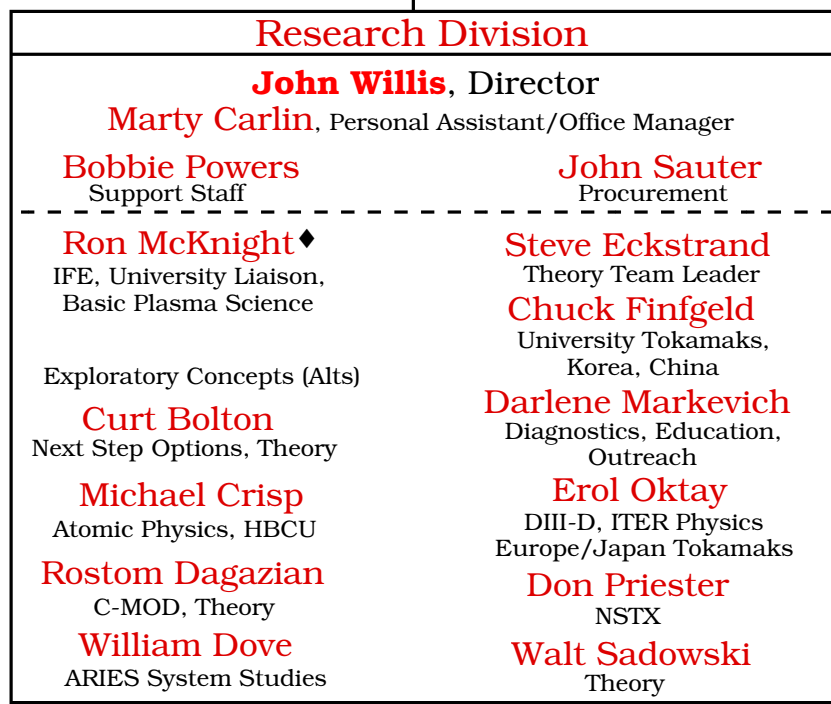
By

**Michael Roberts**

Director of International Activities  
Office of Fusion Energy Sciences  
Office of Science  
Department of Energy

April 24, 2000

# Office of Fusion Energy Sciences



♦ Principal Acting Director

\*\*Dual Capacity

4/19/00

## ***U.S. Management of U.S.-JA Bilateral Fusion Activities***

---

### Planning

|                         |  |
|-------------------------|--|
| M. Roberts              | Director, International Activities; U.S. Executive Secretary |
| R. McKnight<br>E. Oktay | Fusion Physics Planning Committee                            |
| W. Wiffen               | Planning and Coordinating Meeting (PCM) on Fusion Technology |
| D. Frame                | Administrator  |

### Research

|                     |   |
|---------------------|---|
| M. Roberts          | Director, Facilities and Enabling Technologies Division |
| J. Willis           | Director, Research Division                             |
| Key U.S.<br>Persons | Office of Fusion Energy Sciences and Field Institutions |

# ***U.S. Fusion Energy Sciences Program Mission and Goals***

---

## Program Mission

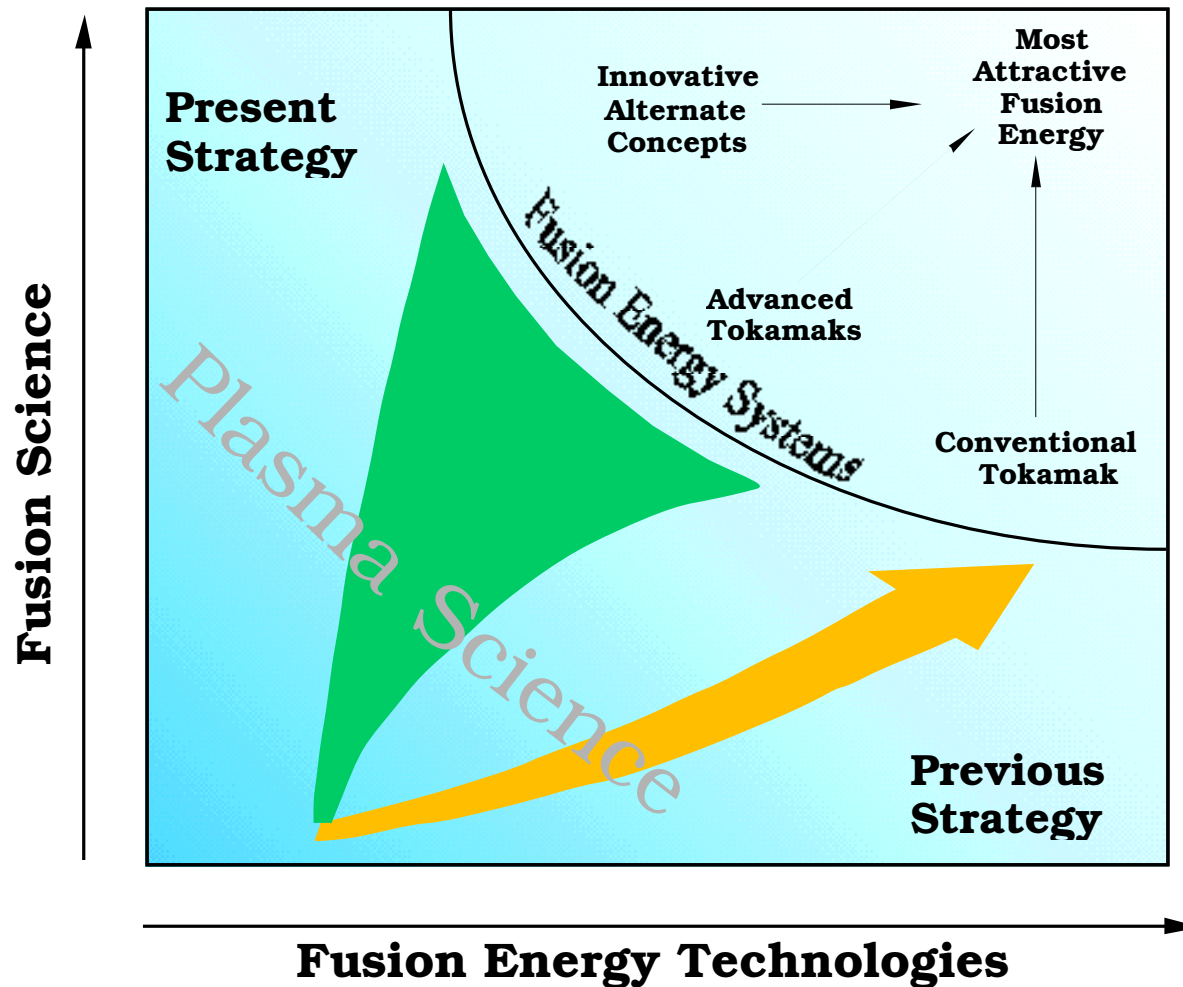
Advance the **knowledge base** needed for an **economically** and **environmentally** attractive fusion energy source.

## Program Goals

- o **Understand** the **physics of plasmas**
- o **Identify** and **explore** innovative approaches to fusion science and technology
- o **Explore** the **science** and **technology** of **energy producing plasma**, as a partner in an international effort

# ***Restructuring of the U.S. Fusion Energy Sciences Program***

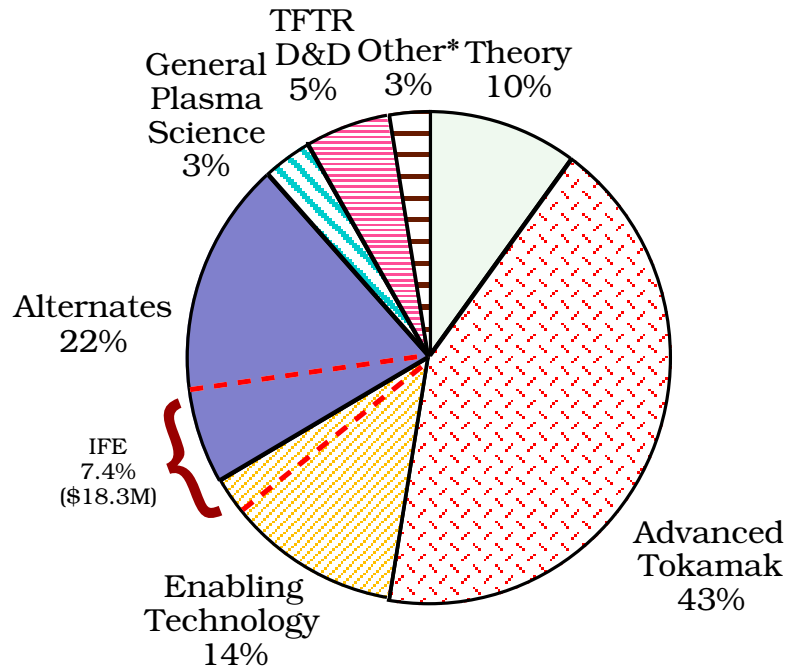
---



# Fusion Energy Sciences Budgets

\$ in Millions

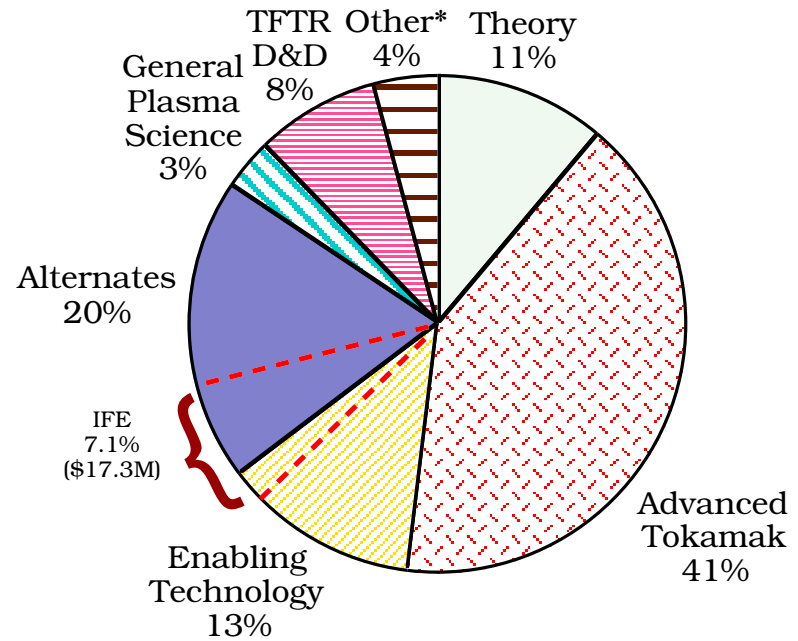
## FY 2000 Appropriation



**Total \$244.7M**

Other\*  
SBIR/STTR  
GPP  
General Reduction

## FY 2001 Congressional



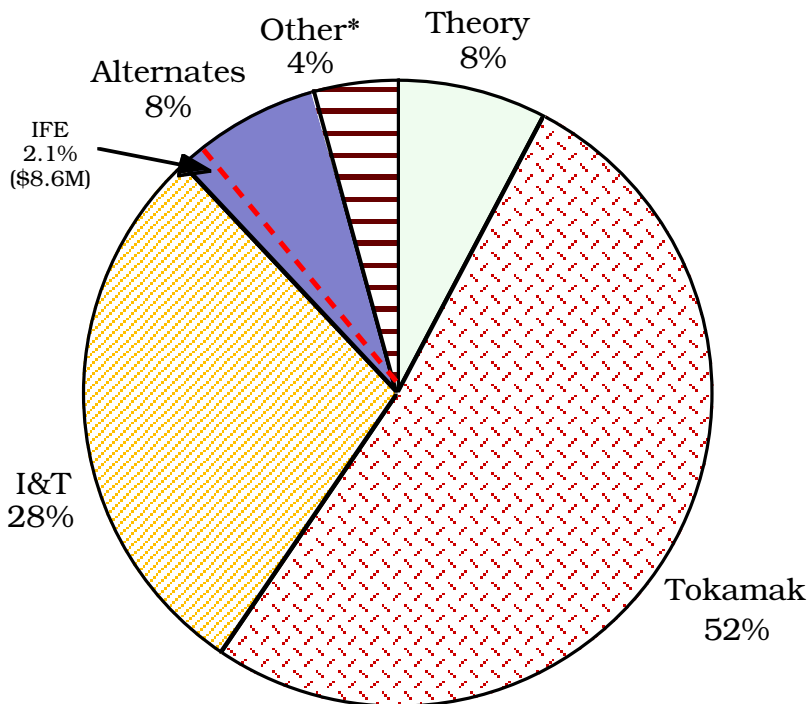
**Total \$243.9M**

Other\*  
SBIR/STTR  
GPP  
Waste Management

# Restructuring Changes in Fusion Energy Sciences Budget

\$ in Millions

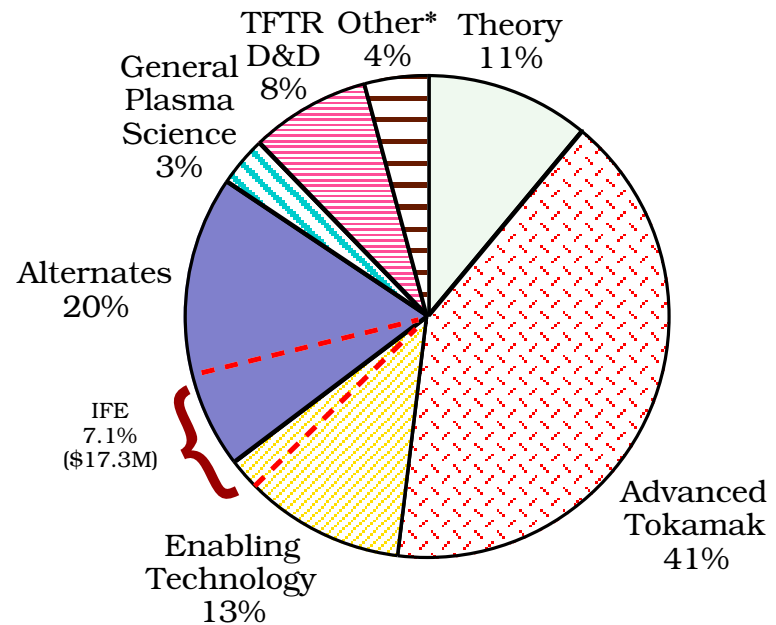
**FY 1996  
President's Request  
in FY 2000\$**



**Total \$404.1M**  
(FY 2000\$)

Other\*  
SBIR/STTR  
GPP  
Program Direction

**FY 2001 Congressional**



**Total \$243.9M**

Other\*  
SBIR/STTR  
GPP  
Waste Management

## ***Fusion Energy Sciences Budget 1996-2001***

---

(As Spent)

|         |         |
|---------|---------|
| FY 1996 | \$238.9 |
| FY 1997 | \$224.7 |
| FY 1998 | \$224.2 |
| FY 1999 | \$222.6 |
| FY 2000 | \$244.7 |
| FY 2001 | \$243.9 |



## ***FY 2000 Fusion Budget Highlights***

---

- o Maintain major FY 1999 funding increases in Alternative Concepts, Theory (computation), and IFE that resulted from redirection of ITER funds
- o Completion of ITER closeout and R&D elements and some additional reduction of technology elements has led to additional increases in science activities and initiation of TFTR Decontamination and Decommissioning (D&D)
  - Increases in Alternative Concepts for:
    - Exploratory Experiments (strengthen base) +\$0.8M
    - Reserve for Proof of Principle Experiments (requires recommendations from FESAC) +\$3.9M
  - IFE +\$0.3M
  - Increase in Theory +\$0.5M
  - Increase in DIII-D & C-Mod experiments +\$1.7M
  - TFTR D&D (requires total of \$48M over three years) +\$10.0M

## ***FY 2001 Fusion Budget Highlights***

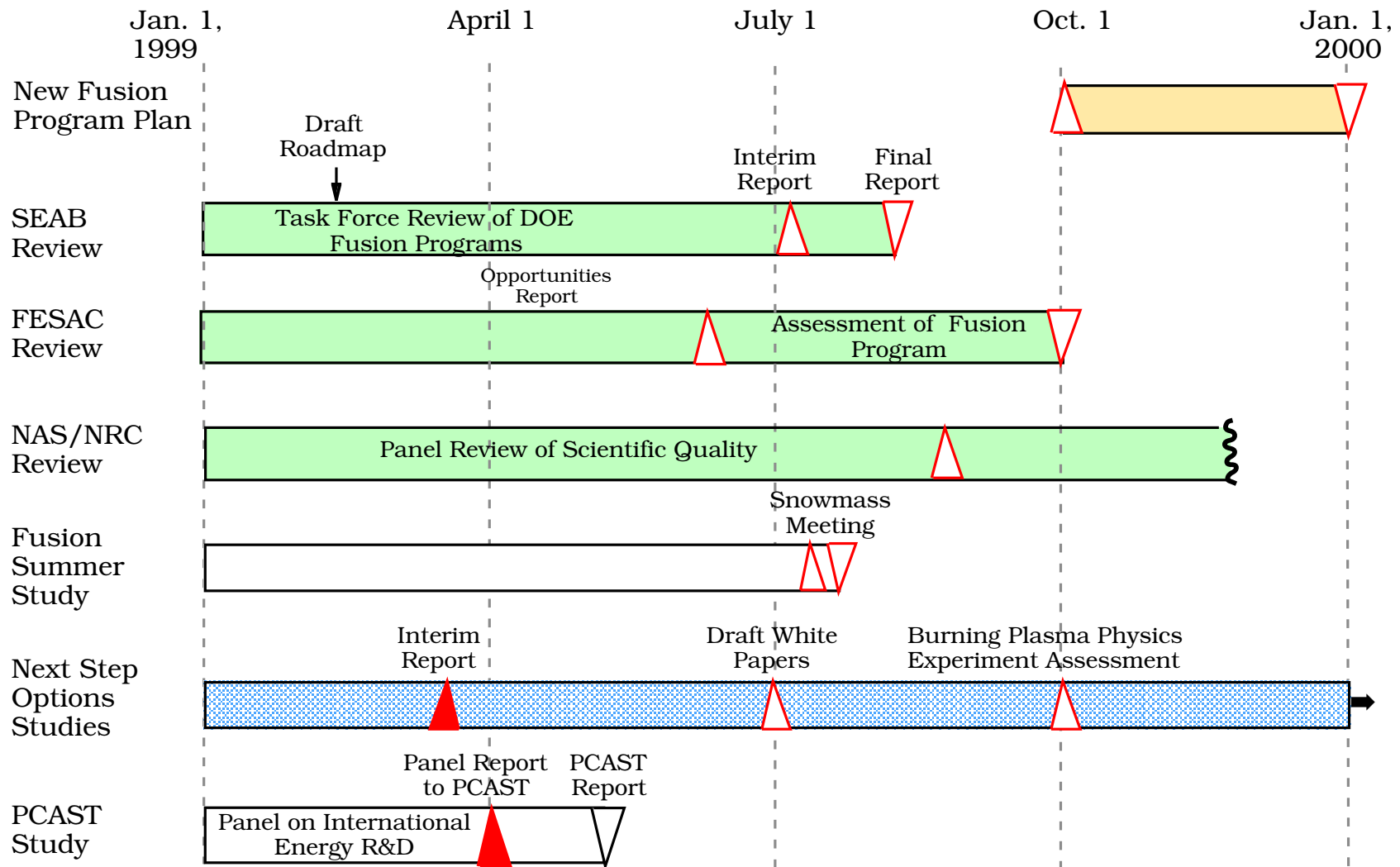
---

0

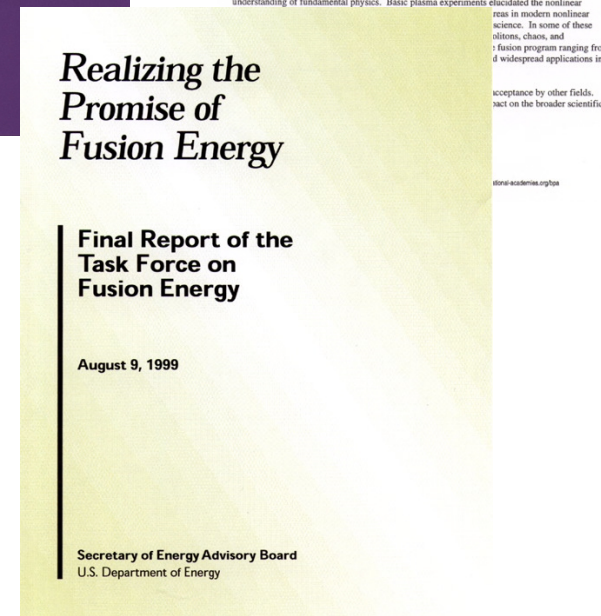
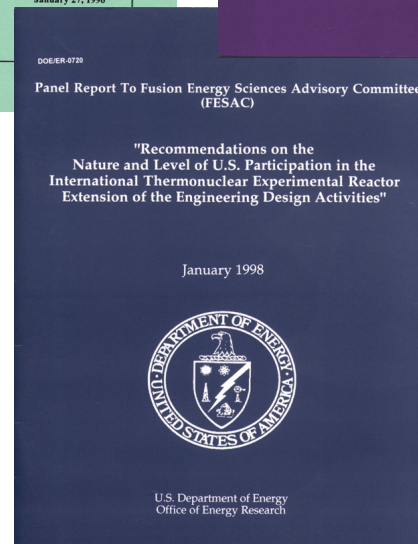
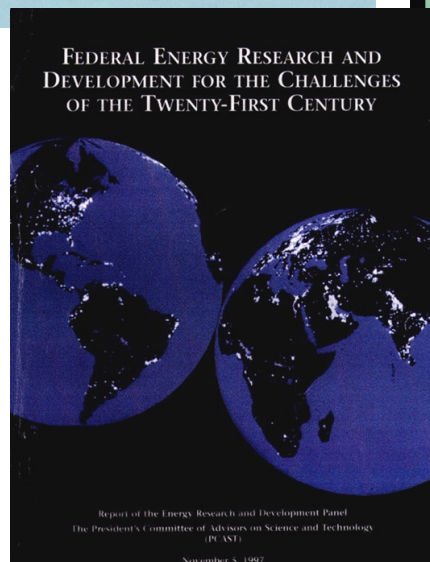
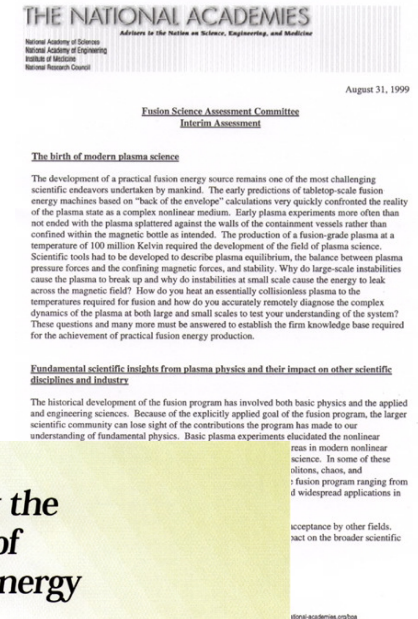
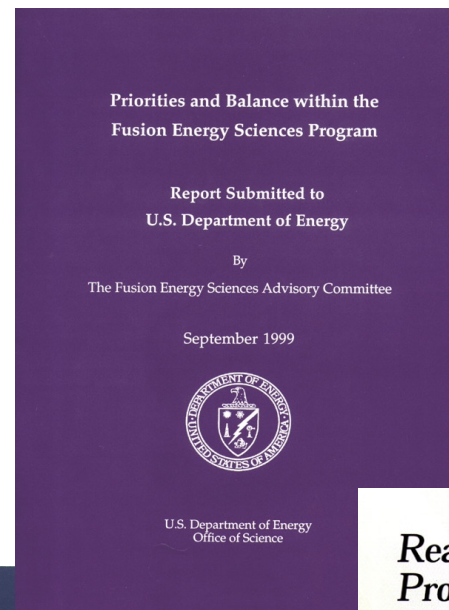
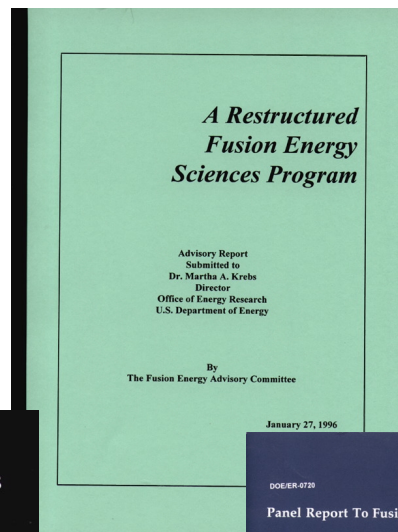
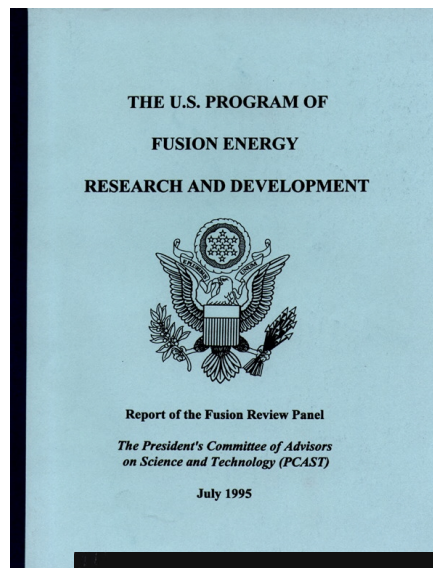
0

- Increases in Alternative Concepts for:
  - Exploratory Experiments (strengthen base) +\$0.0M
  - Reserve for Proof of Principle Experiments (requires recommendations from FESAC) +\$0.0M
- IFE +\$0.0M
- Increase in Theory +\$0.0M
- Increase in DIII-D & C-Mod experiments +\$0.0M
- TFTR D&D (requires total of \$48M over three years) +\$0.0M

# ***Fusion Review and Planning Activities for 1999***



# Major Reviews of the Fusion Energy Sciences Program 1995-1999



## ***Reviews of the Fusion Program***

---

|      |  |       |
|------|--|-------|
| 1999 | Priorities and Balance within the Fusion Energy Sciences Program                           | FESAC |
| 1999 | Fusion Science Assessment Committee, Interim Assessment                                    | NRC   |
| 1999 | Realizing the Promise of Fusion Energy, Final Report of Task Force                         | SEAB  |
| 1998 | Report on the Nature and Level of U.S. Participation in Possible ITER Activities           | FESAC |
| 1997 | Federal Energy Research and Development for the Challenges of the 21 <sup>st</sup> Century | PCAST |
| 1996 | A Restructured Fusion Energy Sciences Program  | FEAC  |
| 1995 | The U.S. Program of Fusion Energy Research and Development                                 | PCAST |
| 1995 | Energy R&D: Shaping our Nations Future in a Competitive World                              | SEAB  |
| 1992 | Letter: Townes to Watkins  | SEAB  |
| 1992 | Report on Program Strategy for U.S. Magnetic Fusion Energy Research                        | FEAC  |
| 1990 | Report of the Technical Panel on Magnetic Fusion of the Energy Research Advisory Board     | ERAB  |
| 1989 | Pacing the U.S. Magnetic Fusion Program  | NRC   |
| 1986 | Report of the Technical Panel on Magnetic Fusion   | ERAB  |
| 1987 | Star Power   | OTA   |
| 1984 | Magnetic Fusion Energy R&D   | ERAB  |
| 1982 | Future Engineering Needs of the Magnetic Fusion Committee on Magnetic Fusion               | NAS   |
| 1980 | Report on Magnetic Fusion Program  | ERAB  |
| 1978 | Final Report of the Ad Hoc Experts Group on Fusion   | FRC   |

## ***FESAC Review***

---

### **"Priorities and Balance within the Fusion Energy Sciences Program"**

- o Culmination of other reviews and workshops
- o Broad community representation and consensus
- o Recommendations for resource allocations
  - Amongst MFE thrust areas
  - Between MFE and IFE
- o Adopted by DOE in allocating FY 2000 funds

## ***Report of FESAC Panel on Priorities and Balance***

---

- o Concluded existing program is basically **well-balanced**

- o Considered **three budget cases** (\$ in Millions)

| <u>MFE</u> | <u>IFE</u> | <u>Total</u> |
|------------|------------|--------------|
| 250        | 50         | 300          |
| 230        | 30         | 260          |
| 207        | 15         | 222          |

- o **Specific goals** were provided for MFE/IFE in all three budget cases
- o For MFE, recommended specific funding increases for:
  - Theory and computation and general plasma science
  - Portfolio of confinement concepts
  - Moderate-pulse advanced tokamak program
  - Enabling technology program
- o IFE work in fusion energy sciences program should continue to focus on high average power:
  - Efficient and affordable drivers
  - Associated chamber and target technologies

# ***Report of FESAC Panel on Priorities and Balance***

## **(continued)**

---

- o Recommendations on MFE Proof of Principle (POP) experiments:
  - **Reversed Field Pinch** is ready for POP designation
    - Focused sequential approach should be implemented
  - **Compact Stellarator** is not ready for POP at this time
    - Awaiting completion of design
    - High confidence of success
  - **Magnetized Target Fusion** is not ready for POP at this time
    - Continue at concept exploration level



# ***SEAB Report***

---

- o Executive Summary

“In light of the promise of fusion and the risks arising from increasing worldwide energy demand and from eventually declining fossil energy supply, **it is our view that we should pursue fusion energy aggressively.**”

- o MFE Program

- Endorses focus of program
- Continue to expand fusion portfolio

- o IFE Program

- Too early to select one driver technology
- Additional detailed engineering studies needed

- o International Collaboration

- Case for stable meaningful engagement is compelling
- Must carefully rebuild foundation and communicate with Congress

## ***SEAB Report*** (continued)

---

- o Balance and Funding
  - Overall funding is sub-critical
  - Any significant increases in IFE funding should come from budget increment
- o Strategy, Management and Structure
  - Continue to emphasize sensible energy path planning
  - Include resolution of engineering/economic issues in planning
  - Establish clear/sensible milestones
  - Initiate integrated program planning
- o Other Issues
  - Remain involved in materials research
  - Steward for plasma science
  - Assure availability of trained scientists and engineers
  - Plan for immense engineering challenges
  - Major player in computer initiatives

## ***NAS/NRC Interim Assessment***

---

The Fusion Science Assessment Committee's interim findings include:

- o Fusion is one of the most **challenging** scientific endeavors undertaken
  - Drove the development of modern **plasma science**
  - Provided key applications of modern **nonlinear physics**
  - Plasma physicists leaders in **emerging fields**--e.g. solitons, chaos, and stochasticity
- o *Restructured program is responsive to the NRC report **Plasma Science: From Fundamental Research to Technological Applications***

## ***Fusion Summer Study***

---

- o Over **1/3 of the 850 scientists** in the U.S. fusion program plus 25 foreign participants met for 2 weeks this summer
  - Broad support for **technology research** supporting both inertial and magnetic fusion energy
  - Broad support for **burning plasma physics** for magnetic fusion energy
- o Substantial technical basis for FESAC review

---

Summary viewgraphs at:

[www.ap.columbia.edu/fusion/snowmass/WG\\_Summaries.html](http://www.ap.columbia.edu/fusion/snowmass/WG_Summaries.html)

## Summary Conclusions

---

- o U.S. fusion is a **science program** with a specific energy vision
- o The review and planning activities this year **will assess** both the **science** and **energy aspects** of the fusion program
- o The budget constrains the **size** and **scope** of the fusion program
  - MFE is dependent upon **international collaboration**
  - IFE is dependent upon **inertial confinement** fusion science
- o Reviews and planning meetings will lay the foundation for **future progress toward** fusion science and energy **goals**